

## **WDFW HABITAT GUIDELINES**

Planning, design and ecological considerations in process based natural channel design for habitat restoration, including channel configuration, riparian function, sediment transport, hyporheic function and flood plain connectivity. Channel design parameters are addressed, including specific habitats (spawning, rearing, holding, riparian, etc.), habitat forming structures, and off-channel habitats. Page estimates are averages for budgeting purposes and may vary for specific sections but not overall.

### **1 HEADING PLACEHOLDER – DO NOT DELETE**

### **2 HEADING PLACEHOLDER – DO NOT DELETE**

### **3 HEADING PLACEHOLDER – DO NOT DELETE**

### **4 SELECTING A RESTORATION OR REHABILITATION APPROACH**

Selection of an approach to restoration or rehabilitation at a particular site, reach or stream requires consideration of numerous factors unique to each project, including:

- Stream system and watershed condition,
- Societal constraints,
- Multi-party objectives, and
- Ecological community condition, limitations, and requirements.

The process generally involves an initial identification of issues or problems within the stream and watershed, evaluation of causes of stream habitat degradation, identification of restoration limitations, identification of alternative restoration approaches and opportunities, and consideration of these alternative approaches.

#### **4.1 Problem Identification**

*(2-3 pages for following sections 4.1.1 to 4.1.4 in total)  
(no figures anticipated)*

##### **4.1.1 Define Problem**

Habitat restoration or rehabilitation may be justified when habitat deficiency and its causes have both been clearly identified. The first step in the process of identifying restoration solutions is to identify the habitat deficiency. Habitat deficiencies may be expressed either biologically or physically. A biological expression of habitat deficiency will be expressed as a lack of or decline in productivity, habitat use, or population. Biological expressions of habitat deficiency are commonly identified through biological assessments, through monitoring of fish populations, or through limiting factor analysis. A physical

expression of habitat deficiency may similarly be expressed as a lack of or decline in the physical habitat quality, or a rate of change in physical characteristics that implies instability.

Habitat deficiencies can manifest themselves in an infinite number of ways. However, most problems can be categorized as deficiencies in habitat elements. Habitat elements include:

- Pool, resting, deep water, and cover habitat
- Spawning gravels, or sedimentation of spawning gravels
- Organic nutrients and food
- Passage and access to habitat
- Water quality and temperature

The identification of habitat deficiencies requires evaluation of both the physical and biological quality of a stream. Biological assessments and limiting factors analyses may be necessary to adequately identify the physical and biological deficiencies in existing habitat. More information on conducting biological assessments and limiting factors analysis is provided in:

- Direct reader to resources for conducting biological assessments, habitat monitoring protocols, and limiting factors analyses.

#### *4.1.2 Identify Cause of Problem*

Once the habitat deficiency has been clearly defined, the second step in the process is to identify cause of the identified problem. Identification of causes is usually accomplished through assessments, as discussed in Chapter 3. Reach and watershed assessments provide the information necessary to begin to identify causes of habitat deficiency problems.

Habitat restoration, rehabilitation, or improvement plans must attempt to identify the causes of stream degradation and habitat loss in order to develop a long-term solution. Stream rehabilitation measures that treat only the symptom of the problem and not the cause will provide only short-term benefit and they will likely need to be repeated periodically to provide continued benefit in the long-term. However, it is important to acknowledge that cause and effect relationships in stream environments can be extremely complex and are often impossible to define with certainty.

The scale of project necessary to restore stream habitat increases with the scale of the cause of the problem. Watershed scale causes of stream habitat degradation require watershed scale changes to restore stream habitat. Such changes require society to take a step back and critically reevaluate our historic, contemporary, and future use and abuse of the land. Restoring the watershed will generally necessitate a conscious decision to alter land use and management practices, which has political, societal, and economic implications

The relationship between an identified problem and its cause may be complex and in some instances, difficult to clearly identify. Differing causes and processes may result in the same result, thereby

confounding explanation or extrapolation/prediction. For example, a stream may incise due to a change in hydrology, a reduction in sediment supply, or a steepening of channel slope. Alternatively a similar cause or process may result in different results. For example, urbanizing hydrologic regime may lead to channel incision, or if sufficient grade control exists, may widen laterally. (Further discussion on the cause and effect of habitat deficiencies is provided in Chapter 2 and in the Geomorphology appendix.)

The cause of habitat deficiencies may be related to site conditions, reach conditions, or watershed scale problems. Understanding the spatial extent of habitat deficiencies can often help to identify whether causes are site-specific or more systemic. Habitat deficiencies that are limited to a specific site often can be explained by site-specific causes. Similarly, reach scale deficiencies may be related to reach-scale causes. However, reach-scale habitat problems are also commonly related to watershed management or land use changes upstream. Thus, the scale of problems cannot be consistently related to the scale of causes.

Site and reach scale problems in a stream system may have similar causes, but the extent of their impacts differ in scale. For instance, the impact of removing one log from the stream may be limited to the loss of one pool. However, removal of all wood from a four mile reach of stream may significantly reduce fish cover, pool habitat, invertebrate populations, and overall habitat diversity; reduce the quality and alter the gravel size distribution of salmonid spawning beds; and cause vertical channel degradation or aggradation due to a reduction in channel roughness and scour mechanisms. These effects may extend upstream and downstream of the wood removal site.

Stream habitat degradation at a particular site or reach may be caused by:

- Physical channel modification or constraints;
- Changes in channel boundary conditions;
- Physical constraints placed on natural channel processes;
- Changes in upstream or downstream reach conditions; or
- Changes in watershed management or land use.

Direct physical modification of the channel includes but is not limited to such activities as deliberate alteration of a channel's planform (e.g., straightening), cross-section (e.g., widening), profile (e.g., dredging, gravel mining), or roughness (e.g., removal or addition of wood or other in-stream structure, armoring of the stream bed or banks). Though direct modification of the channel may be limited to a particular site or reach, its impact may extend to the upstream or downstream channels by changing their boundary conditions.

The boundary conditions of a particular stream reach may be affected by any change in the watershed that takes place outside of that reach. For instance, a stream reach may down cut (vertically degrade) as a result of dredging downstream that lowered the bed of the channel. Other examples of boundary condition changes that take place outside of the stream but may impact a particular site or stream reach

include control or removal of riparian vegetation and floodplain fill or levee construction.

Physical constraints placed on natural channel processes at a site or reach scale include any structure that limits the natural migration and adjustment of a river system, either laterally through bank erosion or vertically through scour and deposition, will likely result in habitat degradation.

The health of the stream is directly related to the health of its watershed. Watershed scale causes of stream habitat degradation or loss may be less obvious and more difficult to link directly to habitat problems. As such, they may be more challenging to remedy. Watershed scale causes control two important variables that influence channel processes – hydrologic regime and sediment supply. Changes in watershed hydrology may result from changes in vegetative cover, development, dams, and diversions. Changes in hydrology usually have a corresponding change in the character and volume of sediment supply, though construction activities, agricultural practices, landslides, bank protection, dredging, and changes of in-stream sediment detention can also affect sediment supply.

#### *4.1.3 Define Objectives*

Habitat restoration project objectives are often initially inspired by a desire to enhance the population of a target species and to address immediate concerns over habitat limitations. When considering a target species, the temptation often is to address only limiting factors, without consideration of the bigger picture. Habitat restoration is most effective if project objectives are expanded to benefit all life stages of all species and if the timeframe of planned benefit is expanded from short-term to long-term or permanent. Emphasis on *ecosystem* restoration, which *supports* “target species” may be more effective than creation or restoration of site-specific habitat elements that directly benefit target species. While such site-specific habitat elements may also be of value, their value will be enhanced through the addition of improved ecosystem process and resultant function.

In short, habitat restoration objectives should:

- Benefit all life stages and all species,
- Be long-range,
- Treat the cause of the problem, not the symptom, and
- Emphasize systemic process health and natural function.

#### *4.1.4 Identify Stakeholders and Interests*

Successful restoration will inherently require involvement from numerous stakeholders early in the process of selecting an approach. Stakeholders may include:

- State and federal resource agencies
- Local government
- Landowners

- Tribes
- Community and related businesses
- Hunters, anglers and other recreationists
- Environmental advocacy organizations

Project objectives development will benefit from inclusion of all impacted, interested, and involved parties. Each stakeholder brings to the table their own set of objectives, some of which may benefit fish and wildlife while others may not. Early stakeholder involvement provides the designer with an opportunity to address all concerns and to maximize benefits to fish and wildlife in a cost-effective timely manner. The longer stakeholder involvement is delayed, the more likely the project will be rejected by stakeholders and will require design modification in order to proceed. Early stakeholder involvement may yield a project that addresses multiple project objectives. It also provides each stakeholder with a sense of ownership to the project that can help to bolster community support, encourage donations of money, materials, and services to design, construct, monitor, and maintain the project. And it may also provide current or future opportunities for stream habitat restoration.

#### *4.1.5 Identify Limitations to Meeting Project Objectives*

There are many possible societal, political, and logistical project constraints to address. The myriad of stakeholders contributing to the development of project objectives will facilitate the identification of potential hurdles and roadblocks in the path to implementation. Again, the earlier these roadblocks are identified, the earlier they can be addressed. Project implementation may be limited by:

- Permitting. Numerous federal, state, and local permits may be required in order to implement a project, even if its goal is to restore stream habitat. Permits sometimes take years to obtain, especially if endangered species may be positively or negatively impacted by project. Permit requirements may sometimes conflict, causing further delays while these conflicts are resolved.
- Regulatory authority. When a number of regulatory entities are involved, the degree of authority of each agency is sometimes unclear.
- Resistant stakeholders. Unwilling stakeholders (often landowners or business interests) may prevent any project from proceeding or limit the extent of the project such that restoration objectives cannot be met.
- Funding. Project funding and donations may be insufficient to cover the implementation cost.
- Watershed condition. Change in watershed condition, such as urbanization, may be permanent or irreversible.
- Resource management policy. Current management policies and protocols may conflict with restoration goals.
- Infrastructure. Existing infrastructure may limit the spatial extent of remedies.

While significant limitations to restoration opportunities often exist, stakeholders should consider whether limitations perceived or absolute, and can limitations be removed through negotiation or additional funding and alternatives. Stakeholders should consider how limitations affect whether or not the project is truly able to restore habitat or whether it will simply be an enhancement project. Where limitations to complete restoration exist, there may be alternative rehabilitation or enhancement projects that can meet many stakeholder objectives.

#### *4.1.6 Expertise Required*

Streams and aquatic systems are ecologically and physically complex. In addition to often-complicated social and political considerations for habitat restoration, the complexity of river systems requires an understanding of many related sciences and disciplines. No one discipline can fully address the needs of the ecosystem or the project. Early phases of project planning, including identification of project objectives and alternatives analysis, will benefit from an interdisciplinary approach and may require expertise from at least several related scientific and engineering disciplines, including:

- Hydrology. Hydrologists determine the impact of watershed change on the hydrologic regime and can help to identify causes related to hydrologic impacts, and to evaluate alternatives with respect to altered hydrologic regimes.
- Geology and fluvial geomorphology. Geologist can identify geologic inputs and controls to the channel, such as sediment sources natural grade control. Geomorphologists evaluate the stability and form of the stream channel and the inputs and processes that result in form and degree of stability.
- Fish biology and aquatic ecology, including aquatic entomology. Aquatic life scientists are essential to identifying habitat condition, population studies, and limiting factors analysis.
- Botany and plant ecology. Plant ecologists and botanists evaluate riparian condition, which influences channel stability, habitat structure, nutrient loading, and hydrologic variables.
- Wildlife and conservation biology. Wildlife biologists provide information and analysis of terrestrial, amphibious, and avian species that depend on and influence stream habitat.
- Engineering, including geotechnical, hydraulic and sediment transport disciplines. The evaluation and design of restoration, rehabilitation, and other stream habitat projects often relies on analysis, modeling, and assessment provided by professional engineers with expertise in hydraulics, sediment transport, and geotechnical engineering.